REMARKS

The Examiner's final Office Action of July 9, 2003 has been received and its contents reviewed. Applicants would like to thank the Examiner for the consideration given to the above-identified application.

By the above actions, claim 1 has been amended. Accordingly, claims 1, and 4-5 are pending for consideration, of which claim 1 is independent. In view of these actions and the following remarks, reconsideration of this application is now requested.

Referring now to the detailed Office Action, claims 1 and 4-5 stand rejected under 35 U.S.C. §103(a) as unpatentable over Razouk (U.S. Patent No. 5,581,110A) in view of Schwalke (U.S. Patent 5,416,041A). In response to the rejection, Applicants have amended claim 1, as shown above.

A novel features of the amended claim 1 resides in a) a plurality of element isolation grooves or trenches are provided with respect to one element formation region, b) a region other than the element formation region, i.e., non-element formation region, is provided between the plurality of trenches, and c) the plurality of trenches and the non-element formation region are continuously covered by a third insulating film. Support for the amendment can be found at least in, e.g., Fig. 13 and page 24, lines 24 to page 25, line 8 of the present specification.

Applicants respectfully assert that Razouk completely fails to disclose the plurality of trenches. Further, contrary to the Examiner's allegation that cited Schwalke discloses a plurality of trenches in column 1, lines 16-20, Schwalke completely fails to disclose the aforementioned specific features b) and c) of the present invention. Hence, the combination of Razouk and Schwalke still result in a deficient of feature b) wherein a non-element formation region is provided between the plurality of trenches, and c) wherein the plurality of trenches and the non-element formation region are continuously covered by a third insulating film of the present invention.

The Examiner asserts that Razouk discloses, in Fig. 13, a third insulating film 1302 that corresponds to the third insulating film in the present invention. However, as illustrated in Fig. 14 of Razouk, the third insulating film 1302 is eventually patterned into a nitride cap 1402 covering only one trench. Hence, Razouk fails to disclose the third insulating film of claim 1 of the present invention.

To facilitate the comparison of the presently claimed invention and that of Razouk, Applicants are attaching herewith Attachment Figs. A-F.

Fig. A is a simplified illustration of the presently claimed invention. The insulating layer in Fig. A corresponds to, for example, the third insulating film 211 of Fig. 13 in the present invention. In addition, Fig. B illustrates an example showing a structure that would result in accordance to the assertions made by the Examiner and the actual disclosure by Razouk. That is, Fig. B illustrate a would-be structure of Razouk, if Razouk were to include a plurality of trenches as asserted by the Examiner. Note that in Fig. B, each trench is covered with each different insulating layer corresponding to, for example, the nitride cap 1402 of Fig. 14 in Razouk.

On page 3, lines 8-10 of the Final Office Action, the Examiner asserts that as Razouk teaches covering the trench with layer 1302, it is obvious that the second trench would be covered also, the trenches being continuously covered, based on Fig. 13 of Razouk. In other words, the Examiner asserts that Razouk discloses the features shown in Fig. A. However, Applicants respectfully submit that, according to column 6, lines 64-67 of Razouk, which states: "if the additional step illustrated by Fig 13 is inserted, the formation of the oversized trench mask shown in Fig. 14 and subsequent etching process will result in the structure illustrated in Fig. 14 rather than the structure in Fig. 10". In other words, if the SiN layer 1302 were patterned so that Razouk could have a plurality of trenches as asserted by the Examiner, the structure to be expected from Fig. 14 of Razouk would be that shown in Fig. B.

Referring back to Fig. A, the present invention utilizes the structure illustrated in Fig. A to achieve the effect of reducing stress. Fig. C schematically illustrates the generation of stress in the case where heat treatment and the like are being performed after the step of forming the structure illustrated in Fig. A.

In contrast with Fig. C, Fig. D schematically illustrates the generation of stress in the case where heat treatment and the like are performed after the step of forming the structure illustrated in Fig. B. Since there is a significant difference in generation of stress between Fig. C and Fig. D, and in order to reduce crystal defect in the element formation region, the present invention utilizes the structure illustrated in Fig. A.

Moreover, according to the presently claimed invention, the structure illustrated in Fig. A is utilized to achieve the effect of distributing stress to the non-element formation region interposed between the plurality of trenches, and the plurality of trenches are formed with respect to one element formation region to improve the breakdown voltage. Applicants respectfully assert that Razouk and Schwalke both fail to disclose such advantageous effects.

In addition, the present invention also utilizes the structure illustrated in Fig. A to achieve the effect of suppressing current leakage. Fig. E schematically illustrates a leakage path when one of the trenches in the structure illustrated in Fig. A loses its isolation capacity. Fig. F schematically illustrates a leakage path when one of the trenches in the structure illustrated in Fig 13 loses its isolation capacity. Further, in Fig. F, if the wiring layer is composed of polysilicon or the like, the wiring layer and the trench may be in contact. Hence, by comparing Fig. E and Fig. F, it is obvious that the present invention is more superior in suppressing current leakage to the wiring layer than Razouk or its combination with Schwalke would be in suppressing current leakage.

Further, Applicants respectfully submit the following reasons why there is no motivation in combining Razouk and Schwalke.

The Examiner asserts that the SiN used in Razouk corresponds to the SiO_2 used in Schwalke, and since both are used to suppress stress, the SiN in Razouk can be easily substituted by SiO_2. Specifically, the Examiner asserts that the purpose of the second and third insulating layers of Razouk and Schwalke are to reduce the stress of the insulation structure (Razouk abstract, Schwalke, column 2, lines 4-6 and 34-36), as shown in page 3, lines 17-19 of the Final Office Action. However, this assertion is incorrect.

According to Razouk, the reason for forming the SiN film on the sidewalls of the trench is as disclosed in the following statement: "... the thin nitride layer 702 lines the trench 302 walls and bottom and serves to prevent further oxidation of device layer 108 and to minimize verticals bird's beak formation in subsequent processing steps" (see column 5, lines 5-9 of Razouk). In other words, Razouk discloses preventing the oxidation of silicon, and as a result, preventing the generation of stress that causes the change in volume due to the oxidation of silicon. Hence in Razouk, the SiN that functions as an oxygen barrier is required, and without the oxygen barrier, the junction of stress cannot be achieved.

With regard to "column 2 lines 4-6 and 34-36" asserted by the Examiner as a citing the purpose of the second and third insulating layers of Razouk and Schwalke, Applicants respectfully submit that the alleged disclosure is not found Schwalke. Rather, Schwalke's col. 2, lines 4-6 merely discloses bird's beak leads to mechanical stress at the upper edge of the trench as well as at the floor of the trench, and lines 34-36 merely disclose, due to a field oxide bird's beak fashioned laterally of a trench that is etched into a substrate of monocrystalline silicon, mechanical stresses that occur due to the oxidation of the surface of the trench are reduced at the surface of the substrate.

According to Schwalke, the amorphous silicon is crystallized after forming on the trench sidewalls, and thereafter thermal oxidized. In other words, a silicon oxide film is formed on the trench sidewalls and the silicon oxide film is a thick oxide film (according to the embodiment, the thickness is 400 nm). The reasons why the thickness of the oxide film formed by thermal oxidation in Schwalke is greater than that in the present invention and Razouk are as follows. The shape of the thermal oxide film at the end portion of the trench is controlled to reduce the mechanical stress. Hence, if a thin insulating film such as that in the present invention and Razouk is used in Schwalke, the above mentioned effect of stress reduction by controlling the shape cannot be achieved.

Moreover, in Schwalke, the insulating layer on the trench sidewalls is formed by thermal oxidation of silicon, unlike the second insulating film in the presently claimed invention that is formed by vapor deposition method such as CVD. The CVD silicon oxide film disclosed in the embodiment of Schwalke is an oxide film used for filling the trench, and not an insulating layer formed on the trench sidewall to maintain breakdown voltage.

For the foregoing reasons, there is no motivation in substituting the SiN oxygen-barrier film, which is formed on the trench sidewalls by CVD, in Razouk by the SiO_2 shape-controlled film, which is thickly formed on the trench sidewalls by thermal oxidation, in Schwalke.

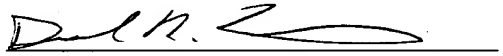
The requirements for establishing a *prima facie* case of obviousness, as detailed in MPEP § 2143 - 2143.03 (pages 2100-122 - 2100-136), are: first, there must be some suggestion or motivation, either in the reference themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference to combine the teachings; second, there must be a reasonable expectation of success; and, finally, the prior art reference (or references when combined) must teach or suggest all of the claim limitations. As Razouk

and Schwalke are deficient of features b) and c) discussed above, and as there is no motivation to combine the references for the reasons set forth above.

In view of the amendments and arguments set forth above, Applicants respectfully request reconsideration and withdrawal of all pending rejections.

While the present application is now believed to be in condition for allowance, should the Examiner find some issue to remain unresolved, or should any new issues arise which could be eliminated through discussions with Applicants' representative, then the Examiner is invited to contact the undersigned by telephone in order that the further prosecution of this application can thereby be expedited.

Respectfully submitted,



Donald R. Studebaker
Registration No. 32,815

NIXON PEABODY LLP
401 9th Street, N.W. Suite 900
Washington, D.C. 20004-2128
(202) 585-8000

FIG. A

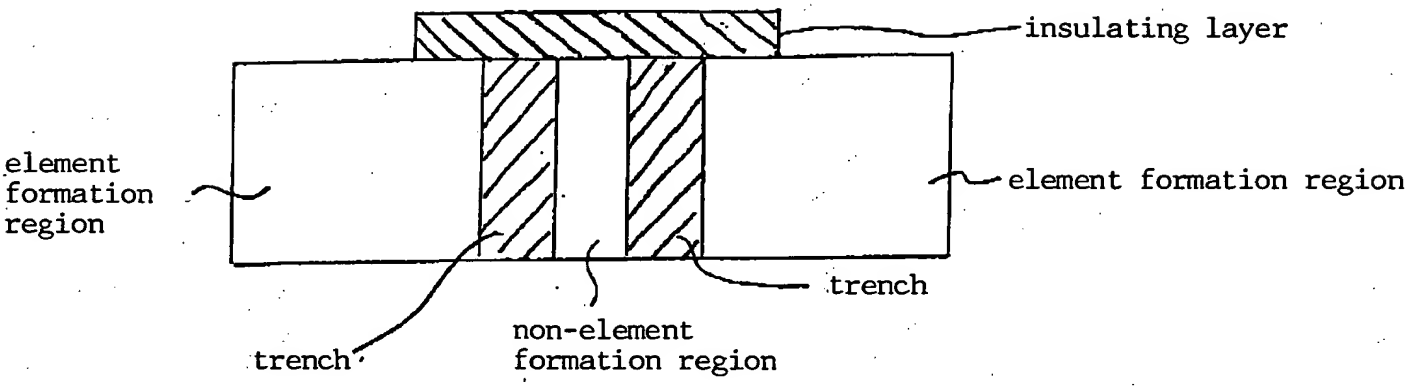


FIG. B (comparison example)

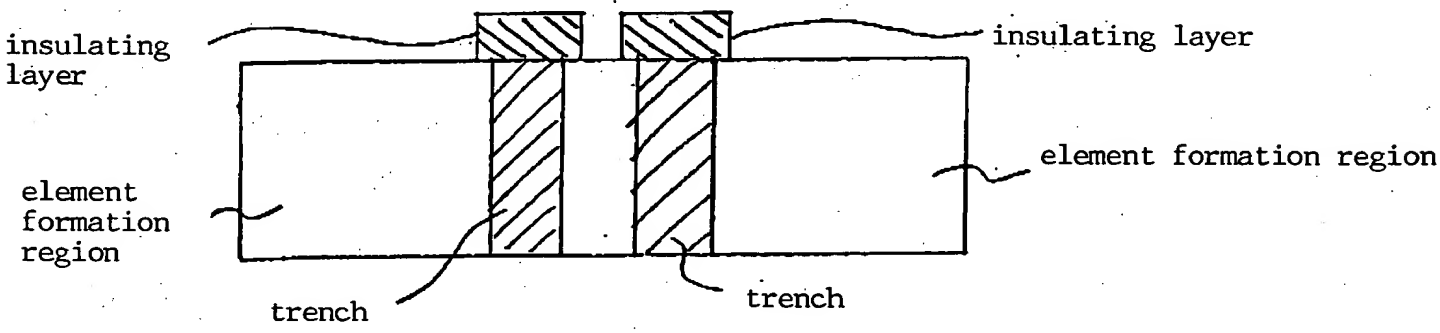


FIG. C

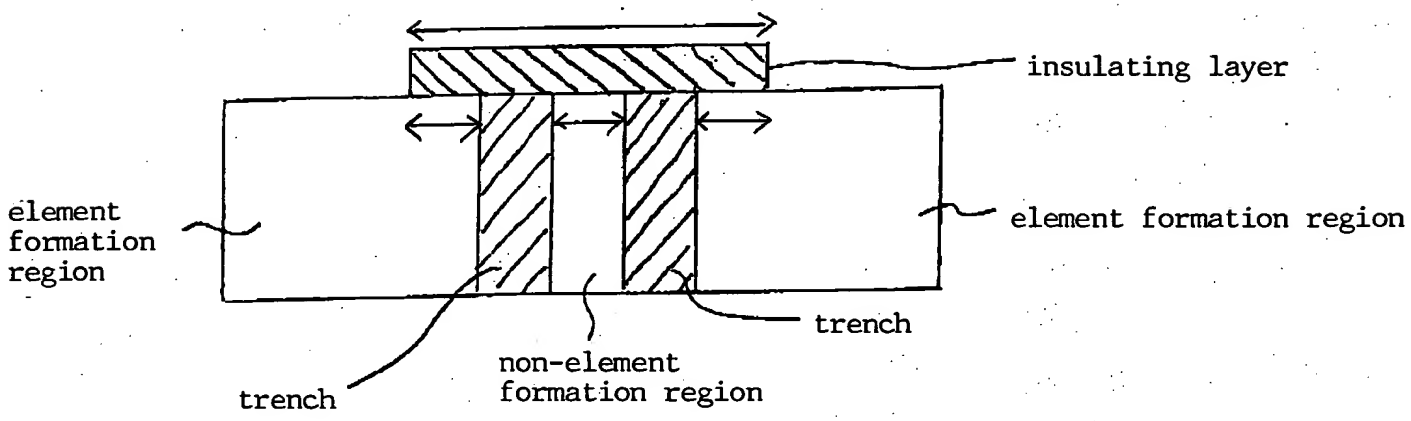


FIG. D (comparison example)

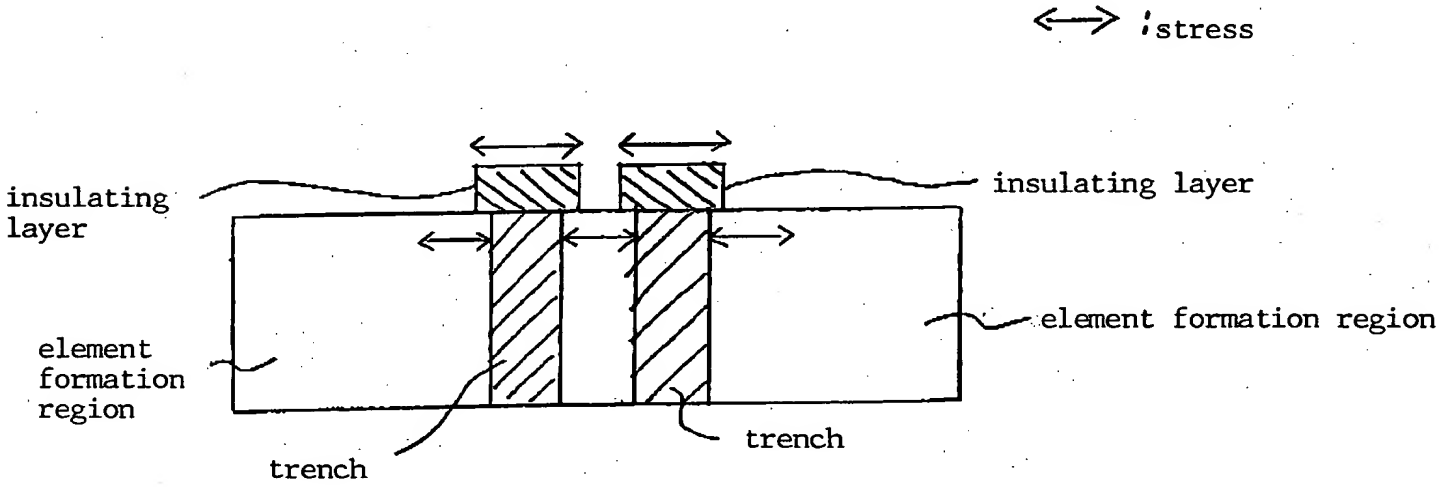


FIG. E

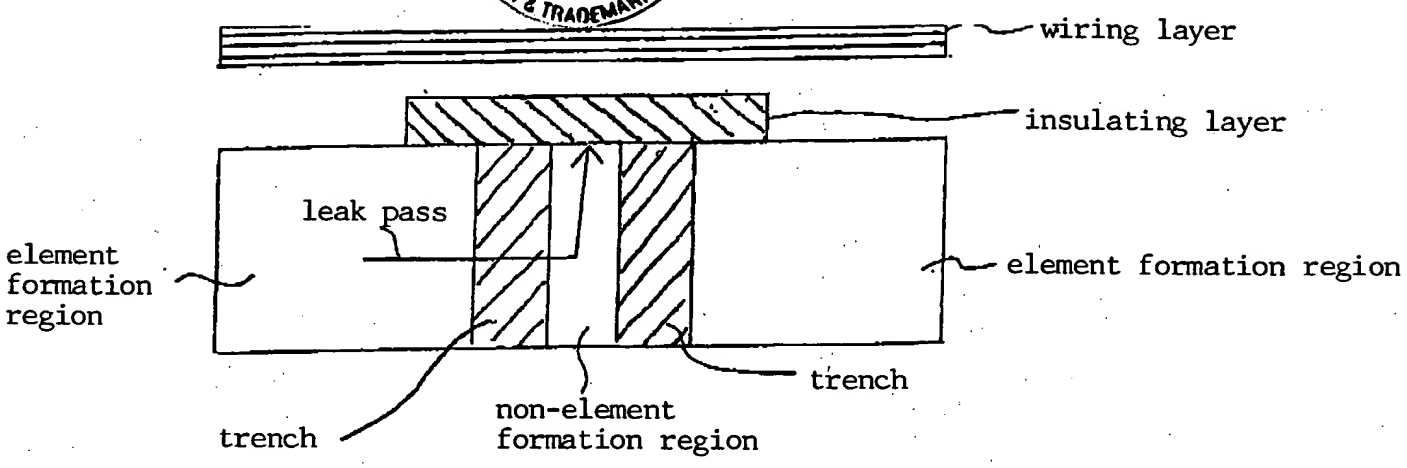


FIG. F (comparison example)